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Page 10: "Potassium compounds appear to be of minor importance in the economy of animals. They occur in the blood of all herbivora as a necessary consequence of their presence in the food."

"Potassium compounds . . . form nearly one quarter of the ash of milk. . . . A farmer producing milk, therefore, will find it profitable to use potash manures unless his soil is naturally well stocked with that ingredient. Practically the whole of the potash in the food, except what is exported in the milk, is returned to the land in the droppings of the animals."

Page 13: Referring to the ingredients of the ash the author says: "From the point of view of the practical cattle feeder they are all unimportant, inasmuch as they are always present in the natural food of the animals."

Page 15: "Carbohydrates are produced by animals only in insignificant quantities."

Page 46: "Fats do not form part of the tissues of plants as they do in animals."

Page 93: "The composition and properties of lactochrome . . . are quite unknown."

Page 99: "The collagen (of bones) acts as a kind of cement and holds the particles of mineral matter together."

Page 104: "No means is known by which this difficulty (the presence of metabolic nitrogen in the feces) can be overcome; but the amount of such ingredients is probably small and approximately constant. In practice it is ignored."

Page 109: In discussing the absorption of nutrients and their passage into the blood and to the heart, the liver is not mentioned.

Page 132: "This amount (the maintenance requirement of digestible protein) may be estimated, as previously shown, from the amount of nitrogen in the urine which contains all of the nitrogenous products of metabolism."

Much of the matter relative to foods is of local significance and not applicable to the United States, thus (page 255), referring to the storage of ensilage in a silo, "the expense is greater than that involved in the waste of fodder when the silage is made in a stack."

"When the expense of a built silo or the alternative loss due to charring at the outside of a stack is added to the losses due to fermentation, it is obvious that silage making is not a profitable method of preserving fodder; and is now rarely practised in this country."

E. B. FORBES

AGRICULTURAL EXPERIMENT STATION,
WOOSTER, O.

SCIENTIFIC JOURNALS AND ARTICLES

THE July number (Vol. 15, No. 3) of the *Transactions of the American Mathematical Society* contains the following papers:

H. F. Blichfeldt: "A new principle in the geometry of numbers, with some applications."

F. R. Sharpe and C. F. Craig: "An application of Severi's theory of a basis to the Kummer and Weddle surfaces."

L. P. Eisenhart: "Transformations of surfaces of Voss."

F. R. Sharpe and Virgil Snyder: "Birational transformations of certain quartic surfaces."

G. M. Green: "One-parameter families of curves in the plane."

G. A. Bliss and A. L. Underhill: "The minimum of a definite integral for unilateral variations in space."

L. D. Cummings: "On a method of comparison for triple-systems."

W. R. Longley: "An existence theorem for a certain differential equation of the n th order."

THE June number (Vol. 20, No. 9) of the *Bulletin of the American Mathematical Society* contains: Report of the spring meeting of the society at Chicago, by H. E. Slaught; "On ovals," by Tsuruichi Hayashi; "On the class of doubly transitive groups," by W. A. Manning; Review of Christoffel's *Gesammelte mathematische Abhandlungen*, by L. P. Eisenhart; Review of Vivanti's *Esercizi di Analisi infinitesimale* and Dingeldey's *Sammlung von Aufgaben zur Anwendung der Differential- und Integralrechnung*, by R. C. Archibald; "Shorter Notices;" Heiberg's *Archimedis Opera Omnia*, volume II., Heath-Kliem's *Archimedes' Werke*, and Mænnchen's *Geheim-*

nisse der Rechenkünstler, by D. E. Smith; Study's Konforme Abbildung einfach-zusammenhängender Bereiche, by Arnold Emch; "Notes;" and "New Publications."

THE July number of the *Bulletin* contains: Report of the April meeting of the society in New York, by F. N. Cole; Report of the twenty-fifth regular meeting of the San Francisco section, by Thomas Buck; "The ratio of the arc to the chord of an analytic curve need not approach unity," by Edward Kasner; "A Mersenne prime," by R. E. Powers; Review of Osgood's *Lehrbuch der Funktionentheorie*, by E. B. Van Vleck; "Notes;" "New Publications;" Twenty-third annual list of published papers; and Index of Volume 20.

THE October number (Vol. 21, No. 1) of the *Bulletin* contains: "On a small variation which renders a linear differential system incompatible," by Maxime Bôcher; "The smallest characteristic numbers in a certain exceptional case," by Maxime Bôcher; "On approximation by trigonometric sums," by T. H. Gronwall; "Note on the roots of algebraic equations," by R. D. Carmichael and T. E. Mason; "Remarks on functional equations," by A. R. Schweitzer; "Shorter Notices;" Hadamard's *Leçons sur le Calcul des Variations*, Tome premier, by E. R. Hedrick; Bouteux's *Principes de l'Analyse mathématique*, Tome premier, by J. B. Shaw; Blumenthal's *Principes de la Théorie des Fonctions entières d'Ordre infini*, by G. D. Birkhoff; Riesz's *Systèmes d'Equations linéaires à une Infinité d'Inconnues*, Bowley's *General Course of Pure Mathematics from Indices to Solid Analytic Geometry*, and Fabry's *Démonstration du Théorème de Fermat*, by R. D. Carmichael; Silberstein's *Vectorial Mechanics*, by E. B. Wilson; "Notes;" and "New Publications."

SPECIAL ARTICLES

VITALITY AND INJURY AS QUANTITATIVE CONCEPTIONS

ALTHOUGH a fundamental conception of physiology, the idea of vitality has not been

very precisely formulated. This is not only unfortunate from a theoretical standpoint, but it also has practical disadvantages. The physiologist often finds that the validity of his conclusions depends on selecting material of normal validity for his experiments. When he examines organisms for this purpose he is too apt to find that all the tests of vitality which he employs are uncertain or that at best they lack the precision necessary for quantitative work.

An accurate method of measuring vitality seems therefore to be needed not only for more precise formulation of the conception itself, but also for practical purposes.

The investigations of the writer lead to the conclusion that the vitality of a tissue is so dependent on the maintenance of its normal permeability that we may employ the permeability of protoplasm as a sensitive and reliable indicator of its vitality. We may therefore obtain an accurate measure of the vitality of a tissue by carefully measuring its permeability.

This may be accomplished by determining the electrical resistance of living tissues. This method is rapid and convenient for practical use. It may be applied to pieces of detached tissue or to the intact organism.

The writer began the use of this method by cutting disks from the fronds of the marine alga, *Laminaria saccharina*, and measuring their electrical resistance in a manner which has already been described.¹ Subsequently it was found possible to measure the resistance of intact fronds both of *Laminaria* and of other plants by methods which will be described in detail in a future publication.

As the result of his experience with this method the writer concludes that it is often very difficult to judge of the condition of an organism by its appearance. The tissues on which experiments have been made were found to be capable of losing much of their vitality without betraying it in any way by their appearance. (This was particularly the case with eel grass, *Zostera*, which retained its normal green color and appearance for some days after

¹ SCIENCE, N. S., 35: 112, 1912.